

REMARKS

The present amendments and remarks are in response to the Office Action of December 20, 2004. Claims 1-11 are currently pending. Claims 12-41 have previously been withdrawn. Claims 42-52 have been added and are currently pending.

Reconsideration of the application is respectfully requested in view of the following responsive remarks. For the Examiner's convenience and reference, the Applicant's remarks are presented in the order in which the corresponding issues were raised in the Office Action.

In the Office Action, the following rejections were issued:

- (1) Claims 1-11 were rejected under 35 U.S.C. 102 as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Application No. 2001/0050031 (hereinafter "Bredt"), U.S. Patent No. 5,387,380 (hereinafter "Cima"), U.S. Patent No. 5,204,055 (hereinafter "Sachs"), U.S. Patent No. 4,696,851 (hereinafter "Pryor"), U.S. Patent No. 3,179,730 (hereinafter "Ingrassia"), or Japanese Patent Abstract JP04363808 (hereinafter "Ishikawa") alone or in view of U.S. Patent No. 6,165,406 (hereinafter "Jang") or Popoola et al. (abstract only-Journal Materials Research 1992); and
- (2) Claims 1-11 were rejected under 35 U.S.C. 112, second paragraph, as failing to set forth the subject matter which applicant(s) regard as their invention.

Rejections under 102(a), 102(b) and 103(a)

Before discussing the rejections under 35 U.S.C. 102(a) & (b), it is thought proper to briefly state what is required to sustain such a rejection. It is well settled that "[a] claim is anticipated only if each and every element as set forth in the claims is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil of California*, 814 F.2d 628, 2 U.S.P.Q. 2d 1051, 1053 (Fed. Cir. 1987). In order to establish anticipation under 35 U.S.C. §102, all elements of the claim must be found in a single reference. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 231 U.S.P.Q. 81, 90 (Fed. Cir. 1986), *cert. denied* 107 S.Ct. 1606 (1987). In particular, as pointed out by the court in *W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 220 U.S.P.Q. 303, 313 (Fed. Cir. 1981), *cert denied*, 469 U.S. 851 (1984), "anticipation requires that each and every element of the claimed invention be disclosed in a prior art reference." "The identical invention must be shown in as complete detail as is contained in the...claim." *Richardson v. Suzuki Motor Co.* 9 U.S.P.Q. 2d 1913, 1920 (Fed. Cir. 1989).

Further, before discussing the obviousness rejection herein, it is thought proper to briefly state what is required to sustain such a rejection. The issue under § 103 is whether the PTO has stated a case of *prima facie* obviousness. According to the MPEP § 2142, the Examiner has the burden and must establish a case of *prima facie* obviousness by showing some motivation in a prior art reference to modify that reference, or combine that reference with multiple references, to teach all the claim limitations in the instant application. Applicant respectfully asserts the Examiner has not satisfied the requirement for establishing a case of *prima facie* obviousness in this rejection.

Rejections over Bredt

The Examiner has rejected claims 1-11 as being anticipated by, or in the alternative, obvious over Bredt. Bredt discloses a method for printing three dimensional functional parts. The method provides utilizing a printing composition comprising a mixture of particles including a filler and an adhesive. The composition can also include a fibrous component, a printing aid, and an activating fluid comprising an additional adhesive. Bredt teaches placing a layer of particulate material on a downwardly movable surface of a container. In addition, Bredt teaches that the activating fluid may be applied to the particulate material by means of an electromechanical ink-jet nozzle. Further, the

filler component of the particulate material may be a calcium aluminate compound (as listed amongst several possible filler compounds found in paragraph [0052]) and can be mixed with an adhesive particulate. The activated fluid applied to the particulate material acts as a binder and can include one or more of many listed compounds. However, the Bredt reference is devoid of teaching a three dimensional printing method that utilizes several unique ingredients in specific combination that produce crosslinked three-dimensional objects. It is notable that some of the components the Examiner has relied on to make the present rejection are listed as “printing aids.” Bredt describes printing aids as materials that are added to the powder material (i.e. filler) before printing in order to provide light adhesion between the powder grains, thereby reducing dust formation, [See Paragraph 0056].

In contrast, the presently claimed invention provides a method for solid free-form fabrication of three-dimensional objects that utilizes very specific compounds in combination to achieve a desired result. The method provides the steps of a) applying a particulate blend in a layer, where the particulate blend can include calcium aluminate particulates and polymeric binder particulates; b) dispensing an aqueous polyol-containing liquid vehicle onto an area of the particulate blend to form hydrated cement in the area, wherein the hydrated cement becomes crosslinked; c) hardening the hydrated cement; and d) repeating steps a) through c) such that multiple layers of the cement are formed that are bound to one another, thereby forming the three dimensional object. In other words, the specific method as claimed requires the use of a blend of calcium aluminate and polymeric particulates, which blend is hydrated and crosslinked using polyol compound-containing liquid vehicle to form a hydrated crosslinked cement. For example, one can consider a particulate blend of calcium aluminate and polyvinyl alcohol. In the presence of water (and as enhanced by the presence of a polyol), calcium undergoes a reaction where the aluminate ions disassociate from the calcium. After disassociation, the aluminate ions become crosslinked with the polyvinyl alcohol through a polycondensation reaction to form a hydrated cement compound. During the formation of the cement hydration products, the polymer, and other additives can be trapped in the matrix resulting in a three dimensional microstructure. In addition, metal ions released from the calcium aluminate can crosslink with the polyol to further enhance the mechanical properties of the finished cement product. This feature of the presently

claimed invention is provided by a specific combination of compounds as presently claimed, and such results have been found to be unexpectedly better than the prior art. As such, Bredt lacks at least one element of the presently claimed invention. Reconsideration on these grounds is respectfully requested.

Applicant further contends that claim 1 is not *prima facie* obvious in view of Bredt. As mentioned, Bredt teaches a method for printing three dimensional functional parts. The formulation utilized in forming the three dimensional functional parts can include filler, an adhesive, a printing aid, and an activating fluid. According to Bredt, the filler can be any of a number of fillers, and mentions calcium aluminate as one possible candidate. Bredt also teaches utilizing certain other particles as well. Bredt, however, fails to teach or suggested a method which utilizes a specific blend of particulates that are particularly adapted for use with a polyol-containing liquid vehicle which can be ink-jetted onto the blend of particulates, thereby forming a crosslinked hydrated cement product. In other words, in order to arrive at the claimed invention using Bredt, one would have to specifically pick and choose three key ingredients to work together to arrive at the claimed invention. To make such choices based on Bredt would not have been ascertainable by one skilled in the art, particularly where there is no suggestion to make the specific selections claimed by the Applicant, and where there is not any suggestion that crosslinking is a desired result. Failure to provide such a teaching or suggestion to arrive at the claimed invention renders the presently claimed invention non-obvious in view of the Bredt. Accordingly, Applicant respectfully requests reconsideration of the claims in view of the aforementioned arguments, and withdrawal of such rejections is respectfully requested.

Rejections over Cima and Sachs

Claims 1-11 were also rejected as being anticipated by, or in the alternative, obvious over Cima or Sachs. Cima and Sachs both teach a process for making a three dimensional object by depositing a first layer of a powder material in a confined region and then depositing a liquid binder material to selected regions of the layer of powder material to produce a layer of bonded powder material at the selected regions. Such steps are repeated until the desired object is formed. Both Cima and Sachs teach of the use of a ceramic powder; however, they lack the teaching of using the specific powder claimed in

the present application. The ceramic powder teachings in these references are drawn to the use of alumina, zirconia, zircon, and silicon carbide materials. Cima provides some additional teachings not provided by Sachs, such as the use of other liquids such as linking agents or fixative materials which may be sprayed over the powder surface before printing. For example, small amounts of polyvinyl alcohol could be dissolved in water, which can be used as a fixative material after the water is evaporated, [See Col. 13, lines 34-40].

As discussed above, the present invention teaches utilizing an ink-jet printing process to form a three-dimensional object. The method disclosed provides a powder layer formed from a blend of calcium aluminate and polymeric binder particulates. A liquid vehicle containing a polyol compound is subsequently ink-jetted on the powder particulate layer to form a hydrated cement layer becomes crosslinked. Applicant submits that there are multiple elements of the claimed invention that are not discussed or suggested by Cima or Sachs. In particular, the use of a blend of calcium aluminate and polymeric binder particulates in the initial stages of forming the object is not taught by Cima or Sachs. While it is true that Cima and Sach teach the use of cement powders to aid in the forming of the object, they lack the specific teaching of the aforementioned calcium aluminate/polymeric binder particulate blend. Additionally, there is no teaching of the use of a polyol in a liquid vehicle for ink-jetting on the blend, which causes the formation of a crosslinked hydrated cement. This unique combination enhances the mechanical properties of the finished cement product. Without the teaching of the specific elements as claimed in the present invention, the Cima or Sach reference cannot be held as anticipating the presently claimed invention.

Furthermore, Cima and Sachs lack the specific teaching to establish a *prima facie* case of obviousness. In order for the present invention to be held obvious in view of Cima and Sachs, the cited references must suggest modifying the reference to arrive at the presently claimed invention and do so with a reasonable amount of success. Cima and Sachs lack several teachings that are claimed by the Applicant, and further, the Examiner has not pointed to any teaching in the specification that would suggest making these modifications. Thus, reconsideration on these grounds is respectfully requested.

Rejections over Pryor

Claims 1-11 were rejected as being anticipated by, or in the alternative, obvious over Pryor. A process for forming a multi-layer or hybrid circuit assembly is disclosed in Pryor. The assembly includes at least one ceramic substrate having a layer of foil bonded thereto by a high temperature organic adhesive. Further, additional layers of foil may be bonded to the substrate and stacked to form multi-layer circuit assemblies. The substrate may be formed from an unfired ceramic sheet which may be constituted of materials including calcium aluminate, silicon carbide, zirconia, zircon, beryllia, alumina and mixtures thereof. In addition, the polymeric materials utilized in Pryor are to bond the substrate and the alloy (cladding) layer. In other words, the polymeric materials act as an adhesive layer.

As noted above, the current invention is for forming a solid three-dimensional object using ink-jet technology. The method as claimed provides a blend of a calcium aluminate and polymeric binder particulates. Further, a liquid vehicle containing a polyol compound is ink-jetted onto the blend of particulates to form a hydrated cement which becomes crosslinked. The Pryor reference fails to teach several elements of the presently claimed invention. Particularly, Pryor lacks the teaching of a polymeric binder particulate which is blended with the calcium aluminate. This being stated, Pryor does teach of the use of a polymeric material in the form of a layer that binds a substrate and an alloy layer together. Specifically, the polymeric material as taught by Pryor is used for an adhesive layer. In addition, Pryor lacks the disclosure of ink-jetting a liquid vehicle containing a polyol. In fact, Pryor is even devoid of the teaching of using an ink-jet printing process to form the multi-layer circuitry. Pryor uses an etching method to form the desired circuitry pattern. It appears that the only basis for citing this reference against the Applicant was merely because the reference teaches a substrate that utilized a calcium aluminate compound. Accordingly, Pryor lacks many elements of the claimed invention, and thus, this reference cannot anticipate the claimed invention.

Furthermore, the present invention cannot be held to be obvious in view of Pryor, as Pryor fails to show some motivation to modify that reference to arrive at the claimed invention. Pryor appears to be wholly irrelevant to the claimed invention in that it does not teach any of the key elements described above. For example, there is no teaching or suggestion in Pryor of the use of forming three-dimensional objects by an ink-jetting

process, or that calcium aluminate particulates may be mixed with polymeric binder particulates as a cement mix configured to receive a polyol-containing liquid vehicle. Absent of such teachings or suggestions, the claimed invention cannot be held as being obvious in view of Pryor. Thus, Applicant respectfully requests the rejection be reconsidered and withdrawn.

Rejections over Ingrassia

The Examiner rejected claims 1-11 for being anticipated, or in the alternative, obvious over Ingrassia. The invention of the Ingrassia reference is drawn towards a process of manufacturing prefabricated elements using cement. The elements disclosed can be used to build up walls, partitions, floors, ceilings, panels, etc. Ingrassia does mention using an aluminous cement to form the mortar. The specific aluminous cement used is comprised of 20% of calcium carbonate powder. However, the Ingrassia reference fails to disclose other key elements of the present invention. Specifically, Ingrassia lacks the teaching of forming a solid freeform object from an ink-jet printing process. Moreover, Ingrassia lacks the teaching of using a blend of a calcium aluminate compound and a polymeric binder, and also does not teach the use of a liquid vehicle containing a polyol which is ink-jetted onto the blend of particulates to form a hydrated cement layer. It appears that Ingrassia is focused on forming large objects for building walls, ceilings, etc. Ingrassia is so far removed from ink-jetting technology that one skilled in the art would not even think of modifying the reference to arrive at the claimed invention. Accordingly, since Ingrassia fails to teach each and every element of the claimed invention, or even suggest such an appropriate modification to arrive at the claimed invention, the Applicant respectfully requests that these rejections be withdrawn.

Rejections over Ishikawa

The Examiner has further rejected claims 1-11 as being anticipated by, or in the alternative, obvious over Ishikawa. The abstract of the Ishikawa reference discloses a semiconductive composition material with excellent heat resistance characteristics. Ishikawa provides a polymer grafted with vinyl chloride to and ethylene vinyl acetate copolymer and an ethylene vinyl acetate compolymer to form the semiconductive

composition. In addition, calcium aluminate or calcium silicate may be added to the composition to provide the desired heat resistant characteristics.

In contrast, the present invention is patentably distinguishable from the Ishikawa reference in many respects. The present invention is drawn towards a method for forming a solid freeform article. The method provides a blend of calcium aluminate and polymeric binder particulates which receive an ink-jetted liquid vehicle containing a polyol compound to form a hydrated cement layer. It appears that the Ishikawa reference is irrelevant to the present invention because it lacks almost all essential elements which would be required to maintain an anticipation rejection. The only significant similarity present in Ishikawa is the use of a calcium aluminate compound. However, the use of the calcium aluminate compound is inconsistent with the teaching and uses of the present invention. The calcium aluminate in Ishikawa was added to the semiconductive composition merely to enhance the heat resistant properties. Thus, this material is not added to provide structural bulk. Conversely, the present invention requires the calcium aluminate in forming a particulate blend needed for the forming of a hydrated cement layer. In addition, Ishikawa lacks that teaching that the semiconductive composition may be used in forming a solid three-dimensional object by ink-jetting techniques. Accordingly, Applicant requests that the rejections be withdrawn since Ishikawa lacks the teaching of each and every element, and because it fails to suggest or teach one skilled in the art to modify the reference to arrive at the presently claimed invention. For these same reasons, Ishikawa does not render the claimed invention obvious. Reconsideration on these grounds is respectfully requested.

Rejections over Jang

Also, Claims 1-11 were rejected as being anticipated by, or in the alternative, obvious over Jang. Jang teaches a process for fabricating colorful 3-D objects. The process includes operating a multiple-channel droplet deposition device for supplying and ejecting droplets of multiple liquid compositions containing a solidifiable baseline body-building materials and different colors. As noted by the Examiner in the office action, the Jang reference lacks the teaching of each and every element and is only cited as a secondary reference because it discloses a process that can use a colorant for forming decorative objects. Since, the presently claimed invention is not anticipated by or

obvious over the primary references as discussed above, the rejection in view of Jang is believed to be moot, and Applicant respectfully requests withdrawal of this rejection.

New Claims 42-52

It should be noted that Applicant has added new claims 42-52. The new claims are fully supported in the specification and provide a limitation which Applicant believes is patentable over the prior art cited by the Examiner. Because these claims include a limitation that is nowhere to be found in any of the cited references, a full discussion of each reference with respect to this limitation is not thought necessary. Specifically, claims 42-52 are drawn to methods for solid free-form fabrication of three-dimensional objects, wherein the step of accelerating the hardening of the hydrated cement by using a lithium ion source is required. As mentioned, this limitation is neither taught nor suggested by any of the references previously cited. This lithium ion source can be present in the particulate blend or the liquid vehicle. Accordingly, Applicant believes that claims 42-52 are patently distinct from the abovementioned references because they fail to teach at least one element recited in these claims; and further, all of the cited references are devoid of any teaching or suggesting that would lead one skilled in the art to invention set forth in claim 42. Therefore, Applicant respectfully requests consideration and allowance of these claims.

Rejections under 35 U.S.C. 112, second paragraph

The Examiner has also rejected claims 1-11 under 35 U.S.C. 112, second paragraph, for failing to set forth the subject matter which Applicant regards as the invention. Particularly, the Examiner has pointed to the language “predetermined” as being indefinite as found in claims 1 and 2. Though the Applicant disagrees with this assertion, the Applicant has amended claims 1 and 2 to remove the identified language as suggested by the Examiner. Withdrawal of this rejection is respectfully requested.

CONCLUSION

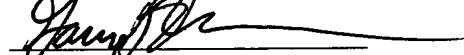
In light of the above discussion, Applicant believes that claims 1-11 and 42-52 present allowable subject matter and allowance is respectfully requested.

If any impediment to the allowance of these claims remains, and such impediment could be resolved during a telephone interview, the Examiner is invited to telephone the assignee's counsel, W. Bradley Haymond at (541) 715-0159, so that such issues may be resolved as expeditiously as possible.

Please charge any additional fees except for Issue Fee or credit any overpayment to Deposit Account No. 08-2025.

Dated this 21 day of May, 2005.

Respectfully submitted,



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